Opioid-Sparing Anesthesia Protocol: An Educational Intervention to Improve Knowledge and Confidence Among Anesthesia Providers

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Dedication and Acknowledgments

I would like to dedicate this project to my amazing wife, Michele, for always loving and supporting me throughout this long and difficult educational journey through all its ups and downs. I would also like to thank my parents and family for their love and support, my best friends David and Emily for being my lodging and support system during my out-of-town clinical rotations, my project partners Alex and Jason for their contributions and help, the anesthesia faculty at UNCG for teaching me all I know about nurse anesthesia, and to all of the preceptors that have supported and believed in me through this entire educational process. I would not be where I am today without you. Thank you all so very much.

Abstract

Background: Opioids have been a mainstay in analgesia for millennia but have numerous untoward side effects, including nausea, vomiting, excessive sedation, ileus, respiratory depression, pruritus, urinary retention, and a large potential for abuse, misuse, and physical dependency. Newer evidence also indicates increasing reports of other concerning adverse reactions such hyperalgesia, immunosuppression, infection, and increased risk of tumor recurrence. These adverse effects can increase recovery times, increase length of hospital stay, increase morbidity and mortality, and increase hospital costs. Other classes of medications can target different pain pathways in the nervous system and decrease amounts of opioids needed in the entire perioperative period. Limiting opioid use during the intraoperative phase has been shown to be beneficial to patients and improve outcomes including decreased nausea and vomiting, decreased time to extubation, comparable post-operative pain scores & opioid consumption, and decreased PACU length of stay. It can also help combat the ever growing opioid crisis in the United States.

Purpose: The purpose of this project was to encourage the use of multimodal and opioid-sparing anesthesia among anesthesia providers with a goal to improve confidence and facilitate the transition of this technique so that it can become standard practice.

Methods: Using the most current evidence, an opioid-sparing anesthesia protocol was developed and placed on a quick reference guide. An educational module was also created and distributed to anesthesia providers at a community hospital along with a pre-intervention survey to measure perceived self-confidence in administering opioid-sparing anesthesia. After five months of implementation, a post-intervention survey was then distributed to see if there were any significant changes.

Results: Due to small sample size and high attrition rate, there was no statistically significant difference in perceived confidence level after the implementation of the protocol. Approximately 76% of the pre-intervention survey sample somewhat or strongly agreed that they were confident in providing opioid-sparing anesthesia.

Recommendations and Conclusion: Additional interventions to address provider confidence could be implemented, such as having a best-practice advisory in the electronic medical record. Providers could be reached out to personally and asked if they feel motivated by the opioid epidemic or other factors to incorporate opioid-sparing anesthesia into their practice, and if they do not feel confident providing opioid-sparing anesthesia to determine what factors need to be addressed. Continued studies on opioid-sparing anesthesia should take place to address other factors that may motivate anesthesia providers to use opioids or opioid-sparing anesthesia. With the trends in data showing improved patient outcomes and decreased costs, opioid-sparing anesthesia will ideally become standard of anesthesia care in the future.

Key Words: Opioid-sparing anesthesia, opioid-free anesthesia, multimodal analgesia and anesthesia, opioids, morphine, fentanyl, remifentanil, sufentanil, ketamine, dexmedetomidine, dexamethasone, non-steroid anti-inflammatory drugs, NSAIDs, magnesium sulfate, lidocaine, celecoxib, ketorolac, regional anesthesia, confidence, quick-reference guide, addiction, substance-use disorder, opioid crisis.

Background and Significance

Opioids have been a primary analgesic in anesthesia for numerous years but have many well-known undesirable side effects. Opioid receptors are located in the central nervous system and when activated, lead to hyperpolarization and inhibition of neuronal activity (Bajwa et al., 2017). Transmission of signals from the peripheral pain neurons is reduced as it travels to higher central nervous system centers providing a reduction in the sensation of pain. Unfortunately, opioid agonists also stimulate the chemoreceptor trigger zone leading to nausea and vomiting (Bajwa et al., 2017; Fawcett & Jones, 2018). Other unwanted effects include excessive sedation, ileus, respiratory depression, pruritus, urinary retention, and a large potential for abuse, misuse, and physical dependency (Brandal et al., 2017; Enten et al., 2019; Guinot et al., 2019; Jebaraj et al., 2017; Velasco et al., 2019). Newer evidence also indicates increasing reports of other concerning adverse reactions such hyperalgesia, immunosuppression, infection, and increased risk of tumor recurrence (Estebe et al., 2021; Guinot et al., 2019; Lavand'homme & Steyaert, 2017; Wilson, 2019). These adverse effects can increase time in the recovery/post anesthesia care unit (PACU), increase length of hospital stay, increase morbidity and mortality, and increase hospital costs (Guinot et al., 2019; Jebaraj et al., 2017; Velasco et al., 2019).

In addition to these adverse effects, opioids are also highly addictive. Opioid misuse has led to the opioid epidemic in the United States with 16,000 deaths per year attributed specifically to prescription opioids (U.S. Department of Health and Human Services, 2023). Furthermore, over 80,000 opioid-related deaths occurred in the United States in 2021. An estimated 1 in 16 post-surgical patients become chronic opioid users (Brummett et al., 2017; Nelson et al., 2015). These numbers have risen drastically in recent years and are expected to continue to increase.

The anesthesia provider needs to be aware of their role in helping to reduce the opioid crisis while simultaneously providing adequate analgesia for the surgical patient (Soffin et al., 2019).

In response to the opioid epidemic, providers have been researching alternatives to combat the overuse of opioids. Multimodal analgesia is defined as the use of two or more different classes of medications to treat and relieve pain (Velasco et al., 2019). For the purposes of this project and paper, opioid-sparing anesthesia (OSA), multimodal anesthesia, or multimodal analgesia will be used interchangeably, as is often done in the literature. The use of opioid-sparing and opioid-free anesthesia (OFA) has been shown to be beneficial to patients and improve outcomes including decreased nausea and vomiting, decreased time to extubation, decreased PACU length of stay, and comparable post-operative pain scores and opioid consumption (Enten et al. 2019; Grant et al., 2020; Guinot et al., 2019). The use of an educational toolkit has been shown to be successful in the implementation of multimodal analgesia (Sarin et al., 2020). Despite this literature, the author has observed that many anesthesia providers in the Triangle region of North Carolina (Raleigh, Durham, and Chapel-Hill) do not frequently utilize OSA.

Purpose

The objective of this Doctor of Nursing Practice (DNP) project was to encourage the use of OSA among nonphysician anesthesia staff. This was accomplished by providing education on OSA and implementing an OSA protocol using the most current evidence. The goal is to determine if confidence among CRNAs in providing OSA will improve by using a quick reference guide with a protocol to facilitate the transition of this technique into the standard practice.

Review of Current Evidence

To promote the most scientifically sound and best evidence-based practice (EBP), a thorough search of the literature was conducted. Several searches were conducted via CINAHL and PubMed. CINAHL searches included: “anesthesia AND opioid free anesthesia,” “nonopioid or OFA or opioid sparing anesthesia,” “opioid free anesthesia AND systematic review”. PubMed search terms included: “anesthesia AND educational toolkit”, “anesthesia AND opioid free AND opioid sparing”. Multiple queries used on both databases included the following search terms: “anesthesia AND opioid-free AND opioid-sparing”, “opioid-sparing anesthesia AND barriers”, “opioid-free anesthesia AND education”. Searching for intervention articles included the search terms “enhanced recovery after surgery OR ERAS”, “anesthesia AND pain control pathway OR pain management pathway”,” anesthesia AND postoperative pain OR pain score OR pain level”, “anesthesia AND opioid use OR opioid consumption”, “ketamine AND postoperative pain”, “magnesium AND postoperative pain”, “Ofirmev OR acetaminophen OR Tylenol AND postoperative pain”, “lidocaine AND postoperative pain”, “dexmedetomidine OR Precedex AND postoperative pain”, “gabapentin AND postoperative pain”, “Lyrica AND postoperative pain”, and “postoperative opioid use”. Any articles that did not have full-text available were excluded to ensure the study was able to be read in its entirety. All searches were limited to only the past five years to ensure the most current literature. To ensure stronger levels of evidence, additional searches were limited to randomized control trials (RCTs) only, as they are considered the highest quality of evidence. Any literature older than five years cited in this paper were obtained from the references in the current literature. Initial searches returned 75 relevant results and after applying exclusion criteria mentioned earlier, evidence was gathered from 42 articles.

Searches on CINAHL and PubMed showed little to no results on “badge buddy AND cognitive aid”. Therefore, these terms were searched on Google Scholar and yielded three more articles. An additional search on CINAHL and PubMed included the terms “quick reference guide,” “quick reference AND protocol,” “quick reference guide AND anesthesia” which found two additional relevant articles. Statistics regarding opioid overdoses and deaths were obtained from the North Carolina Department of Health and Human Services and the Center for Disease Control and Prevention websites. The author was unable to find any literature on confidence levels and OSA.

Benefits of Opioid-Sparing Anesthesia

For many patients, surgery is their first experience with opioids and is a critical time in the development of opioid addiction – even in opioid naïve patients (Velasco et al., 2019). Any patient exposed to opioids is at risk for long-term use of opioids and the development of substance use disorder, with some opioid naïve patients even having reported taking them over a year after their procedure (Velasco et al., 2019, p.459). Opioid overdoses resulting from substance use disorder claim thousands of lives each year. Per the Centers for Disease Control and Prevention (2021), there were 100,306 drug overdose deaths in the United States during a 12 month period ending in April 2021 – 75,673 of those were from opioid overdoses. According to the North Carolina Department of Health and Human Services (2022), 8 North Carolinians die from opioid overdoses each day, which translates into just over 2,900 deaths per year. Over a 20-year period from 2000 to 2020, over 28,000 North Carolinians died from drug overdoses (NCDHHS, 2022). With the multitude of adverse effects described, different evidence-based analgesic strategies that reduce or eliminate the requirements for intraoperative opioids are needed. Additionally, surgeon prescribing patterns of opioid medications upon patient discharge

also need to be addressed, as this has been associated with the increasing severity of the opioid epidemic (Brandal et al., 2017).

Using OSA can reduce the frequency of adverse effects commonly associated with opioid use. A very well-known adverse effect of opioids is respiratory depression (Enten et al., 2019; Estebe et al., 2021; Guinot et al., 2019; Velasco et al., 2019). Omitting or substantially reducing opioid use in the anesthetic plan has been shown to reduce time to extubation as well as decreased intensive care unit (ICU) length of stay (Guinot et al., 2019). Additionally, research has shown that these patients tend to have less nausea in the PACU when compared to patients that received an opioid-based anesthetic (Enten et al., 2019; Frauenknecht et al., 2019; Grape et al., 2019).

Other studies demonstrated additional benefits including faster return of function and mobility, decreased post-op morbidity and mortality, decreased episodes of hypotension, decreased episodes of shivering, and decreased length of hospital stay (Enten et al., Gabriel et al., 2019; Grape et al, 2019; Wilson, 2019). Post-operative pain score differences were not statistically significant (Enten et al., 2019; Grant et al., 2020) between OSA and opioid anesthesia (OA), while OSA showed decreases in post-operative morphine consumption (Guinot et al., 2019; Grant et al., 2020), indicating analgesic equivalency. Post-operative nausea and vomiting (PONV) was found to be twice as frequent in patients with remifentanil infusions vs. dexmedetomidine infusions (Grape et al., 2019). This data shows strong evidence that it is possible to have the same benefits and analgesic effects of OA without the increased risk of adverse outcomes that are associated with opioids.

Multimodal Agents

The concept of intraoperative "pain" is controversial. In 1979, the International Association for the Study of Pain (IASP) defined pain as "[a]n unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (Cohen et al., 2018, p. 2; Treede, 2018, p. 2). Another study expands on this to infer that consciousness is a requirement to experience pain; therefore, while a patient is under general anesthesia, the anesthesia provider is not treating "pain," but rather surgical stress and the ensuing changes in cardiovascular parameters i.e., tachycardia and hypertension (Estebe et al., 2021, p. 86). This implies that patients may be getting exposed to opioids when they do not need them.

There are multiple receptor pathways that can be targeted to address "pain" rather than only opioid receptors. For example, Forget & Cata (2017) showed that both ketamine and magnesium caused less variability in patient hemodynamics during surgery. By targeting these multiple analgesic pathways, non-opioid medications can drastically reduce the amount of opioid exposure in the perioperative period (Clebone et al., 2020). Alternative medications to opioids during the intraoperative period include the n-methyl-D-aspartate (NMDA) antagonists ketamine & magnesium sulfate, the α_2 agonist dexmedetomidine (trade name Precedex), lidocaine, gabapentinoids, acetaminophen, and non-steroidal anti-inflammatory drugs (NSAIDs) such as celecoxib (Celebrex) or ketorolac (Toradol) (Clebone et al., 2020; Enten et al., 2019; Forget & Cata, 2017; Frauenknecht et al., 2019; Jouguelet-Lacoste et al., 2015; Rich, 2005).

NMDA Antagonists – Ketamine and Magnesium Sulfate

The NMDA receptors are significant in the transmission of pain and are found on the terminal synapse of second-order afferent neurons in the dorsal horn of the spinal cord. It is a

voltage dependent, ligand activated receptor, with a calcium channel, that has binding sites for glycine and glutamate and at rest is blocked by magnesium (Bajwa et al., 2017). This is important to note because during consistent nociceptor stimulation, the NMDA receptor will depolarize, opening the calcium channels and lead to increased membrane potential and therefore hyperexcitability which translates to hypersensitivity to pain and decreased opioid responsiveness. This makes this receptor a major target in OSA.

Therefore, ketamine has made a resurgence in anesthesia. It is a known NMDA receptor antagonist and has been studied extensively in clinical settings and shown to reduce opioid requirements, attenuate opioid tolerance or hyperalgesia, reduce nausea and vomiting, and reduced overall pain intensity scores (Bell et al., 2006; Estebe et al., 2021; Gabriel et al., 2019; Grant et al., 2020; Jouguelet-Lacoste et al., 2015; Hocking & Cousins, 2003; Kumar et al., 2017; Steele et al., 2022). It is also noted that it is a smooth-muscle relaxant which makes it an effective agent in preventing bronchospasm. Additionally, ketamine has been shown to interact with μ- and δ-opioid receptors (Kumar et al., 2017). As with all drugs, it is important to note that it is a myocardial depressant, which is masked by its stimulation of the sympathetic nervous system. The release of catecholamines leads to increased heart rate, cardiac output, and therefore blood pressure. This in turn may increase pulmonary artery pressures, cerebral blood flow, and cerebral metabolic rate of oxygen consumption as well as increased tracheobronchial secretions.

At a normal resting membrane state, magnesium blocks the NMDA calcium channel. A prolonged stimulus alters the membrane potential leading to the displacement of the magnesium ion block allowing the calcium to pass through the channel, raising the membrane potential and leading to hyperexcitability (Eizaga Rebollar et al., 2017). In recent years, perioperative magnesium administration has been studied for this antinociceptive effect. Current studies and

meta-analyses show that intraoperative magnesium administration may provide relief in that it reduces postoperative opioid consumption and increases time to the patient's first request for pain medicine (Dehkordy et al., 2020; Eizaga Rebollar et al., 2017; Jabbour et al., 2020; Ng et al., 2020).

Dexmedetomidine

Dexmedetomidine, more commonly known by its trade name Precedex, is an α_2 adrenergic agonist that can be utilized as an anxiolytic, analgesic adjunct, and for conscious sedation (Shafer et al., 2015). Due to these properties, it has been researched as an adjuvant drug for use in operating room procedures. It has been found that intraoperative dexmedetomidine led to improved vitals, such as increased mean arterial pressure (MAP) and blood pressure (BP), reduced fentanyl and midazolam requirements with no differences in oxygenation, ventilation, respiratory parameters, and equally rapid extubation times (Aouad et al., 2019; Buckley et al., 2020; Elgebaly and Sabry,2018; Seif et al., 2016; Zhang et al., 2018).

Lidocaine

Lidocaine is an amide type local anesthetic and is frequently used for regional and neuraxial anesthesia. It can also be used systemically to produce analgesia as it suppresses sodium channels in neurons which respond to painful stimuli (Flood et al., 2021). A lidocaine intravenous infusion used perioperatively has been shown to significantly reduce post-operative opioid consumption (Lovett-Carter et al., 2021). It has also been shown to hasten gastrointestinal recovery and reduce nausea and vomiting (Beaussier et al., 2018). There is a concern for lidocaine toxicity, but studies have shown blood concentrations below toxic levels with serum

concentrations slightly lower than with prolonged epidural administration (Beaussier et al., 2018).

Gabapentinoids

Gabapentin and pregabalin have long been used for neuropathic pain and to prevent seizures. However, gabapentinoids have also been shown to help treat perioperative hyperalgesia and are a recommendation by the American Pain Society for this reason (Joshi et al., 2021). Multiple studies have shown that the use of gabapentin preoperatively can reduce pain scores at 24 and 48 hours postoperatively, reduce nausea and vomiting, reduce dizziness, and reduce opioid consumption (Han et al., 2016; 2016; Li et al., 2017; Rusy et al., 2010; Zhai et al., 2016).

While the mechanism of action (MOA) for gabapentin or pregabalin is not completely known, there are varying thoughts on precisely how gabapentinoids exhibit analgesic effects. Some theories posit that they primarily work on the α_2 δ-1 subunit of voltage gated calcium channels (Chincholkar, 2020). These subunits are highly related to nociception and are increased when an injury occurs. Others theorize that gabapentinoids inhibit neurotransmitter release on those same receptors (Chincholkar, 2020).

Acetaminophen

Acetaminophen or paracetamol, more commonly known by its trade name Tylenol, is a common over-the-counter pain analgesic and antipyretic medication. It is not considered an NSAID like other over-the-counter pain relievers such as ibuprofen or naproxen. Acetaminophen can be used intraoperatively as an adjunct analgesic agent. Recently, an intravenous formulation was released onto the market by the trade name Ofirmev (Gabriel et al., 2019).

The exact analgesic mechanism of acetaminophen is not fully understood but may be related to inhibition of central cyclooxygenase (COX) activity or modulation of the endogenous cannabinoid system (Gabriel et al., 2019). Its use is limited by its hepatotoxicity; therefore, the dosage is limited to 4 g total in a 24-hour period, typically 1 g given every six hours. Acetaminophen can also be given preoperatively; there is currently no evidence that giving preoperatively or intraoperatively is superior (Gabriel et al., 2019). As a result, acetaminophen is typically given in the preoperative holding area.

NSAIDs

Nonsteroidal anti-inflammatory drugs (NSAIDs) are either selective or nonselective COX inhibitors with both analgesic and anti-inflammatory properties (Flood et al., 2021). The COX pathway in the body produces prostaglandins which are upregulated and released after tissue injury. This can cause hyperalgesia and allodynia. NSAIDs inhibit the synthesis of arachidonic acid and therefore prostaglandins.

Ketorolac, a nonselective COX inhibitor, reduces pain and sensitization. In a meta-analysis, patients given ketorolac had a 9% to 66% reduction in patient-controlled analgesia (PCA) opioids and a 59% reduction in rescue medication (Martinez et al., 2019). Celecoxib, an NSAID selective for COX-2 inhibition, documented a decrease in 24-h opioid consumption, pain scores, and postoperative nausea and vomiting with preoperative celecoxib administration for non-cardiac surgery (Gabriel et al., 2019; Murto, et al., 2015). Celecoxib is typically given by mouth in the preoperative holding area.

Post-operative Pain Scores

Several retrospective analyses (Enten et al., 2019; Estebe et al., 2021; Guinot et al., 2019; Hofer et al., 2017) showed that post-operative pain scores were not significantly different between patient groups that received multimodal analgesia compared to OA. Two RCTs compared the efficacy of the α_2 agonist dexmedetomidine as the sole analgesic agent compared to fentanyl (Jebaraj et al., 2017) and remifentanil (Grape et al., 2019). They both showed that the two drugs were equivalent in their analgesic properties. A literature review of low-dose or sub-anesthetic dose ketamine infusions demonstrated that post-operative opioid consumption was decreased by 40% and no major complications were reported (Jouguelet-Lacoste et al., 2015).

Need for Education and Cultural Changes

Addressing practitioner opinion and perceived barriers to the paradigm shift to OSA is of the utmost importance, and it should begin during formal training. A qualitative study by Velasco et al. (2019) consisted of a series of semi-structured telephone interviews with local certified registered nurse anesthetists (CRNAs) in the Chicago metropolitan area, who gave their opinions on what hinders them from using opioid-free anesthesia as well as facilitators to its use. Common barriers included limited experience, lack of resources, and preconceived beliefs such as superiority and predictability of an opioid (Velasco et al, 2019). Deep-rooted beliefs are difficult to address, as evidenced by an interviewee quote: “I don’t care what the research shows; I anecdotally see a very poor outcome [with opioid alternatives]” (Velasco et al., 2019, p. 464). Facilitators mentioned by interviewees included positive experiences with multimodal anesthesia, negative experiences with opioid medications, and institutional policy (Velasco et al., 2019). An additional survey among CRNAs showed younger anesthesia practitioners were more

likely to use OSA; again, likely due to deeply set beliefs and experiences by older providers (Morrow et al., 2021).

The literature shows high levels of quality evidence that OSA is as effective as OA with much less risk of adverse outcomes (Enten et al., 2019; Estebe et al., 2021; Forget & Cata, 2017; Frauenknecht et al., 2019; Grant et al., 2020; Guinot et al., 2019). Provider behavior, opinion, and willingness to change practice need to be addressed to facilitate adoption at facilities that have not yet shifted toward multimodal anesthesia. The next step is to then make the evidence more well-known to anesthesia providers so it can become standard practice and provide an evidence-based tool to facilitate quicker change to the best and most current EBP. One method to achieve this goal is by using cognitive aids such as a quick-reference guide.

Cognitive Aids

A cognitive aid is defined as a prompt designed to assist a worker complete a task or series of tasks – a checklist is a type of cognitive aid that lists sequential actions (Hall et al., 2020). Cognitive aids like these have been commonly used in aviation since the 1930s and, in contrast to guidelines, protocols, or standard operating procedures, are meant to be used while performing the task (Marshall, 2013). As anesthesia is commonly compared with aviation, the same concepts can easily be crossed over. Cognitive aids are particularly useful in emergencies and can reduce errors while increasing performance (Hall et al., 2020; Marshall, 2013; Sarin et al., 2020).

Visual cognitive aids are devices that help to facilitate clinician responses to certain situations, such as critical events, and are likely to be used when perceived to be easy to do so (Clebone et al., 2020). Cognitive aids have also been shown to lead to a reduction in errors and increases in performance (Hall et al., 2020). A cognitive aid that healthcare workers may be

familiar with is a “quick reference guide,” a visual aid that usually sits behind a worker’s ID badge and typically contains a protocol or checklist. They are often more informally called “badge buddies” by most healthcare workers. A toolkit, model, or protocol can easily be placed on one of these quick reference guides where a protocol for multimodal anesthesia can easily be referenced by clinicians.

Conceptual Framework/Theoretical Model

This project uses the Awareness to Adherence model, which was developed to improve physician adherence to a variety of guidelines after administering a survey on pediatric vaccine recommendations to pediatricians and family physicians (Pathman et al., 1996). The model consists of four steps: awareness, agreement, adoption, and adherence. The provider must become aware of the guideline, decide if they agree with the guideline, adopt the guideline, and then continue to follow it at appropriate times (Pathman et al., 1996).

This model is appropriate to the project – the educational module is the awareness step. The second step, agreement, is the decision of the participants to implement the knowledge gained from the educational module and the use of the protocol and quick reference guide is the adoption step. Lastly, those participants that choose to continue using the protocol will have completed the adherence step.

Methods

Design

We performed a quantitative quality-improvement (QI) project involving a pre and post intervention of EBP education with the goal of advancing the anesthesia provider's understanding of OSA. The project included the creation of an educational module on current evidenced-based research with OSA, creation of an OSA protocol, a quick reference guide, and a

pre- and post-intervention survey to evaluate the confidence, barriers, and understanding of OSA. The content of the educational module included the need for OSA as discussed in the background and significance section of this paper, each medication and its MOA, and the protocol we developed. Variables examined by other partners in the project, but not included in this paper, were perceived barriers to OSA and use of OSA in the patient with substance-use disorder (SUD).

Translational Framework

The Plan-Do-Study-Act framework was used for this evidence-based educational project, as it has been shown to be valuable as a problem-solving tool to improve processes and sustain change (Taylor et al., 2014). In the "plan" phase, a change aimed at improvement is identified, it is enacted in the "do" stage, examined in the "study" phase, and the "act" phase identifies adaptations and next steps to continue improvement.

This framework was appropriate for this project, much like the Awareness to Adherence theoretical model described earlier. The "plan" stage involved identifying the infrequent use of OSA and gathering supporting literature, the "do" stage was the implementation of the educational session and distribution of the quick reference guide. The "study" stage involved the collection of data via the surveys to see if the study variables changed and the "act" stage was the formulation of recommendations for future projects or studies.

Permissions

This project has been supported by the clinical site coordinator and approved as an exemption by the University of North Carolina at Greensboro Internal Review Board (IRB) as this QI project does not meet the federal definition of research using human subjects. Participant

protection was of the utmost importance. Participant data was 100% anonymous and personally identifiable information was not collected. Therefore, participants were unable to be tracked from pre- or post-interventional data.

Setting

The project was implemented at a suburban community hospital in the Triangle region of North Carolina. This site offers ten operating rooms, two procedure rooms, and a cystoscopy room. It also provides non-operating room anesthesia (NORA) such as shockwave lithotripsy and anesthesia for radiological procedures. It can provide different types of surgical services from general surgeries to specialty services such as orthopedics, plastic surgeries, and cardiovascular procedures. Permission to use the clinical site for the project was obtained from the hospital's clinical education coordinator.

Sample

We utilized a convenience sample for this project with the hopes of recruiting up to 50 practicing anesthesia providers at this site. This sample size was selected due to a size of at least 30 being the standard minimum needed to obtain generalizability for statistical analysis. The inclusion criteria were to be a current nonphysician anesthesia staff member practicing at this facility; these included CRNAs, and certified anesthesiologist-assistants (CAAs). The only other prerequisites to be included in the project were to be over the age of eighteen, currently practicing at the clinical site, and consent to participate in the project.

The anesthesia providers that actively provide anesthesia care in the operating room were selected as the sample group for this project, which at this hospital are both CRNAs and CAAs, as they will be the ones actively utilizing the protocol and quick reference guide. Physician anesthesiologists (MDAs) were excluded as they typically do not stay in the operating room

throughout the duration of the case. Recruitment methods were multiple emails distributed to the clinical coordinator who would then send them to the nonphysician anesthesia staff. As an incentive to complete the project, a $20 Amazon gift card was provided to each anesthesia provider that completes both pre- and post-intervention surveys.

Instrument

Two Likert-scale questionnaires/surveys were created via Qualtrics software to collect data for this project: a pre interventional survey with 31 questions and the post interventional survey with 34 questions. Most of the questions on the two surveys were identical, with the three additional questions on the post intervention survey asking participants for feedback on the protocol itself. The Likert-scale questionnaire presented questions to the participants with responses that range from "not-at-all" to "always" or "completely agree" to "completely disagree." Questions on the surveys related to provider confidence in using OSA, perception of patients' pain levels on emergence from OSA and OA, and willingness to educate others on OSA. There was also an optional comment item where participants could freely give their thoughts on OSA.

The Likert-scale was selected because it is a self-evaluation tool that allows the participants to answer questions in confidence and allows the researchers to collect data anonymously. It was developed by Rensis Likert in 1932 to measure attitudes on a 5- or 7-point ordinal scale (Sullivan & Artino, 2013). The Likert-scale has been shown to be a reliable and valid tool for self-assessment data collection and is often used in healthcare settings; therefore, it is ideal for the data collection for this project (Joshi et al., 2015).

Procedures

Our project implementation began with distribution of the project consent form (see Appendix A), the project information sheet (see Appendix B), the pre-intervention survey (see Appendix C), an educational pre-recorded PowerPoint module (see Appendix D) via email in September 2022. The OSA protocol on the quick reference guides (see Appendix E) were delivered in person to the clinical site also in September 2022. The emails were sent to the facility's clinical education coordinator, who then forwarded them via email to the nonphysician anesthesia providers that were willing to participate. An in-person presentation was offered as well in February 2023. Multiple recruitment emails were sent from September 2022 to February 2023. After the presentations, the post-intervention survey was distributed in the same fashion (see Appendix F).

Data Collection

Both the pre-intervention and post-intervention surveys were created via Qualtrics to collect data on the following variables: provider confidence providing OSA, provider perception of patient pain when emerging from OSA vs. OSA, whether formal training in OSA was included in their education, and willingness to educate others on OSA. The data collected was stored on password protected private laptops and was completely anonymous, with no identifiable information collected. Due to the anonymity of the surveys, individual participants' responses were unable to be tracked from the pre-intervention survey to the post-intervention survey.

Data Analysis

The data from the Qualtrics surveys was converted into an Excel spreadsheet which was shared on the university's encrypted Google Drive. From there, the data was analyzed via 2-

sample and independent t-tests to determine statistically significant changes and trends in the data from pre to post intervention. Due to the complete anonymity of survey participants, we were unable to use a paired t-test. Statistical significance was determined by $p<0.05$. The optional comments were not analyzed but were provided in this paper for completeness. The statistical consultant for the project was the biostatistics professor at UNC Greensboro. Descriptive statistics such as mean, median, or standard deviation were not used.

Project Budget

No outside funding was utilized for this project. The budget was $1000 for gift card incentives for completion of the project. This was estimated by a predicted sample of 50 anesthesia providers receiving $20 gift cards plus costs for printing quick reference guides.

Results

After the surveys were completed, survey data was tabulated and analyzed. Demographic data in both surveys were also collected (Figure 1). There were a total of 22 participants on the pre-intervention survey and 10 on the post-intervention survey. Not all survey questions were answered by some participants.

Pre-Survey Demographics *n* = 22	Post-Survey Demographics *n* = 10
Gender • Male – 10 • Female – 12 Years Experience (in years) • < 5 – 2 • 5-9 – 8 • 10-14 – 4 • 15-19 – 4 • 20-24 – 3 • ≥ 25 – 1	Gender • Male – 5 • Female – 5 Years Experience (in years) • < 5 – 2 • 5-9 – 3 • 10-14 – 2 • 15-19 – 1 • 20-24 – 1 • ≥ 25 – 1

Figure 1: Survey Demographics

Pre-Intervention Results

The years of experience ranged from 0-5 years to greater than 25 years (see Figure 1). Ten of responses were male and twelve were female. There were no responses for level of education or intent to obtain a doctoral degree therefore these data were not included in the results. Twelve of the participants (n=21) self-reported receiving training in opioid-sparing techniques were in their education (57.14%) and nine did not (42.86%).

For self-reported confidence in using OSA (n=21), one response indicated that they strongly disagreed in having confidence (4.76%) and one response indicated "somewhat disagree" (see Figure 2). Three responses indicated "neither agree nor disagree" (14.29%). Eleven indicated "somewhat agree" (52.38%) and five indicated "strongly agree" (23.81%). When asked if having a quick-reference guide would be helpful in their practice, seven responses indicated "strongly agree" (33.33%, n=21) and seven indicated "somewhat agree" (33.33%). Four indicated "neither agree nor disagree" (19.05%), one indicated "somewhat disagree" (4.76%), and two indicated "strongly disagree" (9.52%).

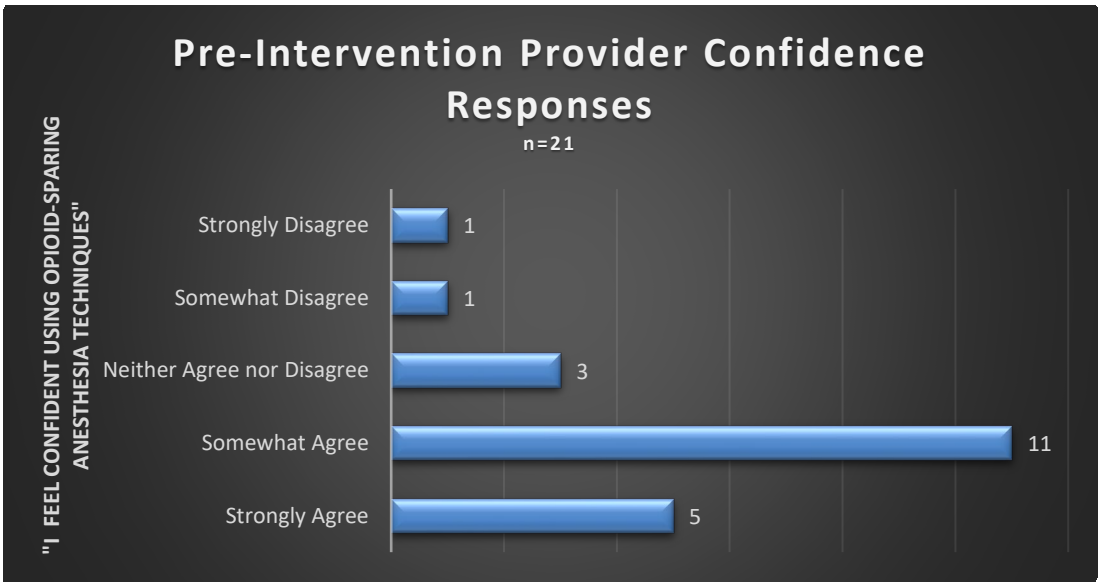

Figure 2: Pre-Intervention Provider Confidence

When asked if participants perceived their patients emerged from anesthesia pain-free when using *opioids* (n=21), four participants indicated "strongly agree" (19.05%) and nine indicated "somewhat agree" (42.86%). Five participants indicated "neither agree nor disagree" (23.81%) and three indicated "somewhat disagree" (14.29%). There were no responses for "strongly disagree." When asked if participants perceived their patients emerging from anesthesia when using *OSA* (n=21), eight indicated "somewhat agree" (38.10%), eight indicated "neither agree nor disagree" (38.10%), and five indicated "somewhat disagree" (23.81%). There were no responses for "strongly agree" nor "strongly disagree" to this survey item. Eight of the 21 participants would be willing to educate others on OSA (38.10%), eleven would *not* be willing (52.38%), and two indicated "maybe/unsure" (9.52%).

Post-Intervention Results

The post interventional survey had a total of ten participants, five were male and five were female (see Figure 1). Seven of the ten participants indicated that their education was at the master's degree level and three had a doctorate level education. Of the seven that had been trained with a master's degree, only one indicated that they were interested in obtaining a doctorate in the future. Six of the ten participants indicated that OSA was included in their training (60%), and four indicated it was not included (40%).

When asked if the participants used the opioid-sparing protocol frequently (n=10), six respondents indicated "somewhat agree" (60%), one indicated "neither agree nor disagree" (10%), one indicated "somewhat disagree" (10%), and two indicated "strongly disagree" (20%). When asked if the participants (n=10) found the protocol to be "useful and/or user-friendly," two indicated "strongly agree" (20%), five indicated "somewhat agree" (50%), and three indicated "neither agree nor disagree" (30%). There were no responses for "somewhat disagree" nor

"strongly disagree." When asked if using the protocol improved confidence in providing OSA (n=10), three participants indicated "strongly agree" (30%), three indicated "somewhat agree" (30%), three indicated "neither agree nor disagree" (30%), and one indicated "strongly disagree" (10%); there was not a response for "somewhat disagree" (see Figure 3).

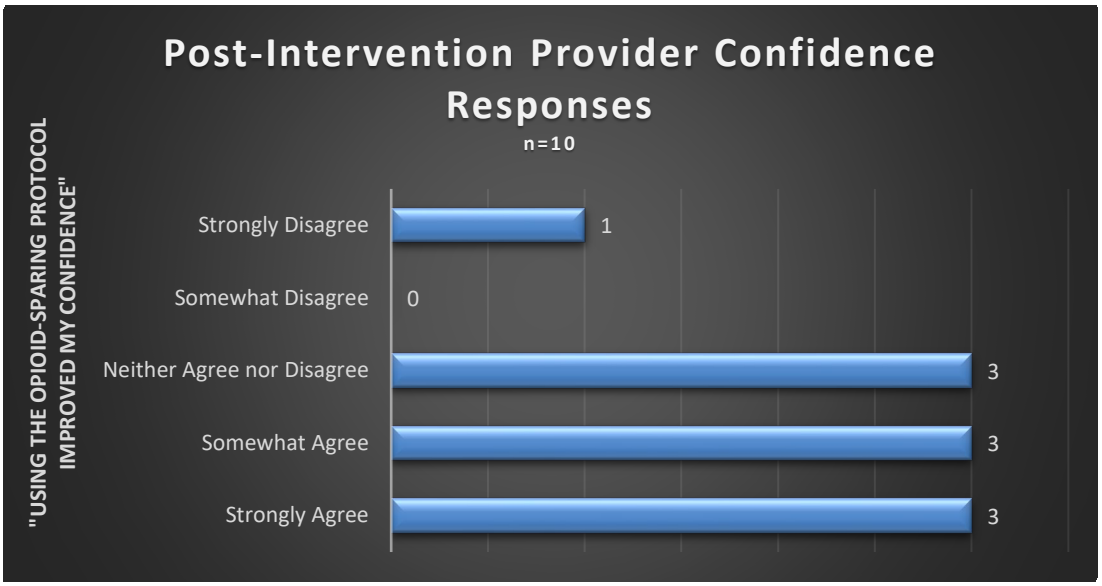

Figure 3: Post-Intervention Provider Confidence

The participants were asked if they feel "immense satisfaction" using OSA; one participant indicated "strongly agree" (11.12%, n=9), four indicated "somewhat agree" (44.44%), two indicated "neither agree nor disagree" (22.22%), and two indicated "somewhat disagree" (22.22%). One participant strongly agreed that the protocol was useful in everyday practice (11.11%, n=9), five indicated that they "somewhat agree" (55.56%), and three indicated they "neither agree nor disagree" (33.33%). There were no responses for "somewhat disagree" nor "strongly disagree."

In comparison to the pre-intervention survey responses, when asked if the participants perceive that their patients wake up pain-free when using *opioids* (n=9), one participant indicated "strongly agree" (11.12%), four indicated "somewhat agree" (44.44%), and four indicated

"neither agree nor disagree" (44.44%). No participants selected "somewhat disagree" nor "strongly disagree." In contrast, when they were asked if they perceive patients waking up pain-free when using *OSA* (n=9), four indicated "somewhat agree" (44.44%, n=9), four indicated "neither agree nor disagree" (44.44%), and one indicated "somewhat disagree" (11.12%). No respondents selected "strongly agree" nor "strongly disagree." When asked if the participants (n=10) would be willing to educate others on OSA, five indicated yes (50%), two indicated no (20%), and 3 were unsure (30%).

For free-text answers, participants were asked to give any other thoughts or opinions on OSA. Only one participant wrote any comment, which is provided verbatim: "We don't do it consistently to truely [*sic*] evaluate, nor do we follow up consistently for effects. I feel sometimes we are "checking a box". We consistently use pre-op meds, but never do infusions[.]"

Inferential statistical analysis of perceived confidence providing OSA between pre-intervention and post-intervention responses did *not* show a statistically significant difference ($p=0.711$, $\alpha<0.05$). Statistical tests included F-test Two-Sample for Variances (two-tail $p=0.414$) and a Two-Sample t-Test Assuming Equal Variances ($p=0.711$). All statistical analyses were performed using Microsoft Excel Data Analysis ToolPak. There were no statistically significant differences with any other variables measured; the p-values are listed as follows: perceived usefulness of having a quick-reference guide protocol ($p=0.972$), provider perception of patient pain level upon emergence of anesthesia using opioids ($p=1$), and provider perception of patient pain level upon emergence of anesthesia using OSA ($p=0.539$). It should be noted that there was significant decrease in the number of responses from the pre-intervention survey to the post-intervention, with a decrease of 45%.

Discussion

The survey findings did not indicate a statistical significance between the use of a quick-reference guide OSA protocol in relation to perceived provider confidence in performing an opioid-sparing anesthetic. However, such a small sample size and large attrition rate essentially negated any ability to generalize to the overall anesthesia provider population. More recruitment emails than originally expected were sent out to try and increase the sample size, but efforts were largely unsuccessful. It should also be noted that after this project was implemented, the author was made aware that the employment turnover has been higher than usual at this specific site and newer employees (many of whom are locums or travelers) may not have been aware of or invested in this project. Also of note, approximately 76% of anesthesia providers in the pre-intervention survey indicated they somewhat or strongly agreed feeling confident providing OSA prior to the distribution of the quick reference guide and educational presentation.

Participants attending the in-person presentation did say they were pleased with the educational module and were complimentary on the presentation. In a similar project by Steele et al. (2022), participation was increased by contacting the providers personally, which is something that could be utilized in future studies on this topic. The results of that particular study demonstrated the ease of use of following the implementation of an opioid-sparing protocol as well as a 94% reduction in opioid consumption in the post-anesthesia care unit (PACU) after implementing an opioid-sparing protocol (Steele et al., 2022). Providers that do not feel confident in providing OSA could also be interviewed in future qualitative studies to determine which contributing factors need to be addressed. The Awareness to Adherence model and Plan-Do-Study-Act translational framework may be useful in these future studies as well.

Limitations

There were many limitations to this study. The largest limitation was the survey size and attrition rate, as discussed previously. With such a small sample, statistical significance practically impossible to determine. Another limitation was the use of a convenience sample, which can potentially introduce bias and decrease generalizability of the results, as it is not a true probability sample (Jager et al., 2017). As also mentioned earlier, there was a large turnover in anesthesia staff from the time the project was implemented until the post-intervention survey was closed and the project completed.

Recommendations for Future Study

Future studies could attempt to reach out to anesthesia providers across an entire health system, not just one hospital. Doing so could potentially increase a sample size to a sufficient quantity to determine statistical significance after implementation of said intervention. More in-person presentations could be given where participants would likely feel more obligated to complete the questionnaires. Additional interventions to address provider confidence could be implemented such as having a best-practice advisory in the electronic medical record. Providers could be reached out to personally and be asked if they feel motivated by the opioid epidemic to incorporate OSA into their practice. Education on OSA and its goals could also be expanded to include PACU nurses who may not realize its benefits and resulting decrease in post-operative opioid requirements and PONV.

Relevance and Recommendations for Clinical Practice

As previously stated, OSA and OFA have been shown to improve patient outcomes by decreasing nausea and vomiting, time to extubation, and post-operative opioid consumption. It also has the potential to save significant hospital costs by decreasing PACU length of stay and

avoiding the need to reintubate patients due to opioid-induced hypoventilation and respiratory failure (Enten et al. 2019; Grant et al., 2020; Guinot et al., 2019). Furthermore, decreased exposure to opioids in the perioperative phase will decrease the chances that patients will become chronic opioid users after discharge; this will help to curb the opioid epidemic.

Another factor that can contribute to the ongoing opioid crisis is physician behavior regarding prescribing habits. Two studies showed that surgeons often prescribe opioid medications at discharge even if the patient has required little to no opioid in the post-operative phase (Brandal et al., 2017; Estebe et al., 2021). Therefore, education on opioid prescribing practices should be extended to surgeons as well.

Conclusion

Opioid-sparing anesthesia has the potential to considerably curtail the opioid crisis in the United States and decrease morbidity and mortality associated with opioid use in the perioperative process. The goal of OSA is not to completely eliminate opioids from the equation, but rather to decrease post-operative opioid requirements by addressing other pain pathways in the body. In doing so, anesthesia providers are helping to provide their patients with the best possible evidenced-based care and improve outcomes, particularly development of substance-use disorder, while also saving healthcare costs. Increasing provider confidence and knowledge will help increase the use of OSA. Further studies on OSA and its frequency of use should be performed until it has become standard of anesthesia care.

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Appendices

Appendix A: Project Consent Form

Dear [redacted] CRNA,

You are being invited to participate in a study titled "Opioid-Sparing Anesthesia in the Non-ERAS Surgical Patient." The purpose of this study is to encourage the use of multimodal opioid-sparing anesthesia among anesthesia providers and identify knowledge gaps, barriers to implementation, confidence, attitudes, and provide information on anesthesia for patients in opioid addiction recovery. This study is being conducted by Charles Moseley, SRNA; Alex Hamad, SRNA; and Jason Mitchell, SRNA in partial fulfillment of the Doctor of Nursing Practice degree at the University of North Carolina at Greensboro. The only inclusion criteria are that you are a currently practicing CRNA over the age of 18.

The project will involve a pre-intervention survey, an educational module, a provided opioid sparing protocol and quick-reference guide, and a post-interventional study. Both surveys will be administrated through Qualtrics and contain 31 items consisting of Likert-scale questions with some free-answer options as well. This survey should take approximately 10-20 minutes to complete. The post-survey will be distributed approximately three months after the pre-survey and educational materials to allow for time to implement the opioid-sparing protocol. The protocol and quick-reference guide will be yours to keep if you choose to participate. This study has been approved by the Institutional Review Board at the University of North Carolina at Greensboro. There are no risks involved to participants in this project.

Participation in this study is completely voluntary and you may withdraw at any time without consequence. Your answers to the survey will be completely confidential. As an incentive, participants who complete both surveys will receive a $20 gift card to Amazon. To ensure that participants complete both surveys and can receive the gift card, the survey will ask for an email address. Inclusion of your email address is voluntary and will be kept in a separate database. It is not required to complete the survey, nor will it be linked to your answers in any way.

By continuing to and completing the pre-intervention survey at the end of this message, you are giving your informed consent to participate in this project. ***Please complete the pre-intervention survey by September 30th.*** If you have any questions or concerns, feel free to contact the principal investigators, Charles Moseley (cfmosele@uncg.edu), Alex Hamad (ashamad@uncg.edu), Jason Mitchell (j_mitch2@uncg.edu) or their faculty advisor Joshua Borders (jrborder@uncg.edu). You may also contact the University of North Carolina at Greensboro Institutional Review Board at 336-256-0253. The authors declare no conflict of interest. Thank you for your consideration to participate in this project!

If you agree to participate in this project, please proceed to the pre-intervention survey by following the link or QR code provided.

https://uncg.qualtrics.com/jfe/form/SV_b4mXX2wQkZb45pk

Appendix B: Project Information Sheet

IRB Information Sheet

Project Title: Opioid-Sparing Anesthesia in the Non-ERAS Surgical Patient

Principal Investigators: Charles Moseley, SRNA; Alex Hamad, SRNA; Jason Mitchell, SRNA

Faculty Advisor: Joshua Borders, PhD, DNP, NP-C, ACHPN

What is this study about?

We are asking you to participate in this research study because opioids have many well-known undesired side-effects. These adverse effects can increase times in the recovery/post anesthesia care unit (PACU), increase length of hospital stay, increase morbidity and mortality, and increase hospital costs. In addition to side effects, Opioid misuse has led to the opioid epidemic in the United States with 16,000 deaths per year attributed to prescription opioids. This project is designed to educate and encourage the use of opioid-sparing anesthesia and increase the confidence of its practice to reduce the overall use of opioids. This research project will only take about one additional hour of your time. There are 2 surveys that should each take about 15 minutes and there is one educational session which should last approximately 30 minutes. **Your participation in this research project is voluntary.**

How will this negatively affect me?

Other than the time you spend on this project there are no known or foreseeable risks involved with this study. There is a minimal risk of breach of confidentiality. However, no identifiable information will be collected or linked to your name. Survey data will be stored on a password and firewall protected drive. Data will only be retained during the study period and will be deleted at the completion of the study.

What do I get out of this research project?

You may benefit from this project by gaining knowledge on an anesthetic technique you may not be as familiar with. Your patients may also benefit from this project. Opioid sparing techniques in anesthesia have been proven to reduce post-operative pain and increased patient satisfaction. In providing education on opioid sparing anesthesia and a protocol, it is believed that providing education on evidenced-based techniques can improve patient outcomes and their satisfaction.

Will I get paid for participating?

You will receive a $20 Amazon gift card for participating in this project.

What about my confidentiality?

We will do everything possible to make sure that your information is kept confidential. All information obtained in this study is strictly confidential unless disclosure is required by law. No identifiable information will be collected or linked to your name. Survey data will be stored on a password and firewall protected drive. Data will only be retained during the study period and will be deleted at the completion of the study.

The security statement for Qualtrics, the survey tool being used for this project, can be accessed here.

Absolute confidentiality of data provided through the Internet *cannot be guaranteed* due to the limited protections of Internet access. Please be sure to close your browser when finished so no one will be able to see what you have been doing.

What if I do not want to be in this research study?

You do not have to be part of this project. This project is voluntary and it is up to you to decide to participate in this research project. If you agree to participate at any time in this project you may stop participating without penalty.

What if I have questions?

You can ask Charles Moseley, SRNA (cfmosele@uncg.edu); Alex Hamad, SRNA (ashamad@uncg.edu); Jason Mitchell, SRNA (j_mitch2@uncg.edu); or their faculty advisor Joshua Borders, PhD, DNP, NP-C, ACHPN (jrborder@uncg.edu) anything about the study. If you have concerns about how you have been treated in this study call the Office of Research Integrity Director at 1-855-251-2351.

Appendix C: Pre-Interventional Survey

Demograhics

What is your age?

- ○ 25-34
- ○ 35-44
- ○ 45-54
- ○ 55-64
- ○ 65 or older

What is your age?

- ○ 25-34
- ○ 35-44
- ○ 45-54
- ○ 55-64
- ○ 65 or older

What is your gender?

- ○ Male
- ○ Female
- ○ Non-binary / third gender
- ○ [ ] Other
- ○ Prefer not to say

How long have you been a practicing CRNA?

- ○ Less than 5 years
- ○ 5-9 years
- ○ 10-14 years
- ○ 15-19 years
- ○ 20-24 years
- ○ 25 years or longer

Was your nurse anesthesia training a masters level or doctorate level?

- ○ Masters Degree
- ○ Doctorate Degree

If you do not have a doctoral degree, do you plan to obtain one in the future?

- ○ Yes
- ○ No
- ○ N/A, I already have a doctoral degree.

Attitude/Barriers

I believe opioid-free/sparing anesthesia is impractical.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

Opioid-free/sparing anesthesia is of no interest to me.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

I do not plan to include opioid-sparing techniques in my practice in the future.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

Learning opioid-free/sparing techniques is not worth the effort or the time.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

I currently use opioid-free/sparing techniques in my practice whenever possible.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

I believe the opioid epidemic has been exaggerated.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree

- ○ Somewhat agree
- ○ Strongly agree

Opioid-free/sparing anesthesia is less effective than traditional anesthesia including opioids.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

Opioid-free/sparing techniques lead to worsened pain control for patients.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

Our facility culture is supportive of opioid-free/sparing anesthesia techniques.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

I feel as though surgeons at my facility would be willing to adopt opioid-free/sparing techniques.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

Cost may be a prohibitive barrier to implementing opioid-free/sparing techniques at my facility.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

I have access to a variety of anesthesia techniques and equipment such as ultrasound, nerve blocks, epidurals, and spinals.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

I have access to a variety of non-opioid medications such as NSAIDs, ketamine, dexmedetomidine, magnesium, acetaminophen, dexamethasone, and lidocaine.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

Please write any additional comments or thoughts about YOUR attitude or perception of opioid-sparing or opioid-free anesthesia.

Confidence

I feel confident using opioid-free/sparing anesthesia techniques.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

Having a brief reference guide with an opioid-sparing protocol would be helpful in my everyday practice.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

My patients often wake up pain-free when using opioids.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

My patients often wake up pain-free when using opioid-free/sparing techniques.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

Opioid-free/sparing techniques were included in my training or education.

- ○ Yes
- ○ No

I would be willing to educate colleagues on opioid-free/sparing anesthesia.

- ○ Yes
- ○ No
- ○ Maybe/Unsure

Opioid Use Disorder

How often do you provide anesthesia care for patients recovering from opioid use disorder?

- ○ Never
- ○ A few times per year
- ○ Once per month
- ○ Weekly
- ○ Daily

When providing anesthesia for patients IN RECOVERY from opioid use disorder I find it harder to control their pain.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

How often do you provide care for patients with ACTIVE opioid use disorder?

- ○ Never
- ○ A few times per year
- ○ About once per month
- ○ Weekly
- ○ Daily

When providing care for patients with ACTIVE opioid use disorder I find it harder to control pain.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

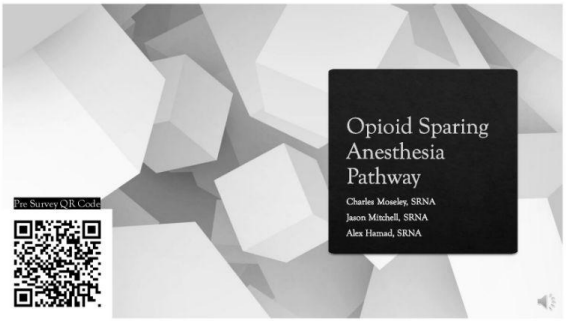
Patients IN RECOVERY from opioid use disorders should NOT be given opioids as part of their anesthetic.

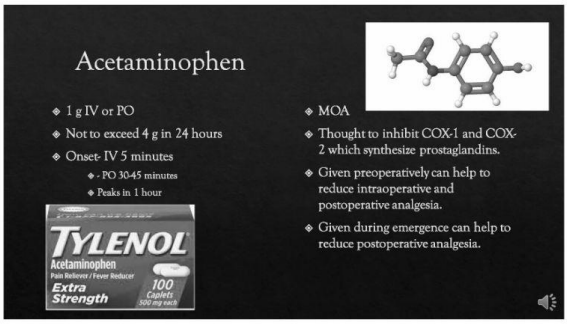
- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

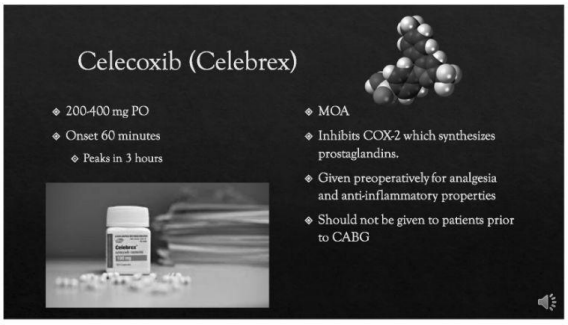
Patients with ACTIVE opioid use disorders should NOT be given opioids as part of their anesthetic.

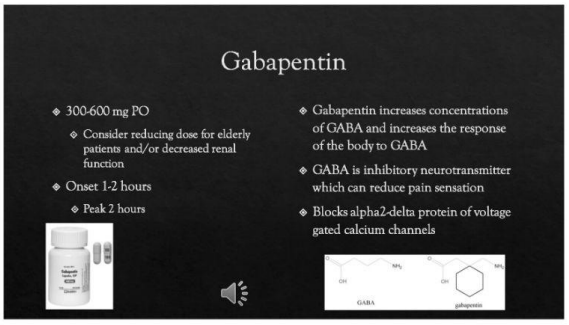
- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

Appendix D: Educational Module



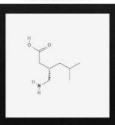




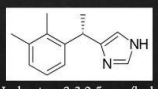


Lyrica

- Similar mechanism of action as gabapentin
  - Alpha2-delta protein
- Reduces neuronal excitability
- 5mg/kg up to 150mg given pre-operatively



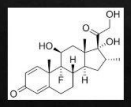
Dexmedetomidine (Precedex)



- Induction- 0.3-0.5 mcg/kg bolus
- Intermittent Bolus- 0.1-0.3 mcg/kg
- Maintenance Infusion 0.1-0.5 mcg/kg/hr
- Onset- < 5 minutes
- Peaks – 10-15 minutes
- MOA
- Primarily alpha 2 agonist with minimal alpha 1 agonist effects
- Decreases release of norepinephrine in CNS and peripheral receptors
- Strong anxiolytic, analgesic, and sedative properties without causing respiratory depression

Dexamethasone (Decadron)

- 0.05-0.2 mg/kg
- Onset 10-30 minutes
- Lasts for up to 72 hours in tissues



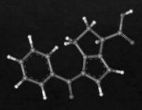
- Glucocorticoid that inhibits production of bradykinin, prostaglandins, histamine, and leukotrienes.
- Has antiemetic, analgesic, and anti-inflammatory properties.
- Can elevate blood glucose levels.
- Administer slowly to awake patients to prevent perineal burning.

Ketamine

- Initial Bolus 0.3-0.5 mg/kg
- Intermittent Bolus 0.1-0.3 mg/kg
- Maintenance Infusion 0.1-0.3 mg/kg/hr
- May cause hallucinations.
- Should be avoided in patients with elevated ICP or history of seizures.
- NMDA receptor antagonist, preventing glutamate from activating NMDA receptors on dorsal horn and preventing transmission of pain signals.
- Has sedative, anti-depressant, anti-hyperalgesia, and bronchodilator properties.

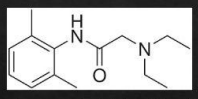
Ketorolac (Toradol)

- 0.5mg/kg up to 30 mg dependent on kidney function
- Onset 10 minutes



- Inhibits COX-1 and COX-2 which synthesize prostaglandins.
- Equivalent to 10mg of morphine for treating analgesia
- May delay platelet aggregation and increase bleeding time
- Caution in use for patients with asthma

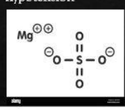
Lidocaine



- Intraoperative Infusion 1-3 mg/kg/hr
- Postop Infusion 1-2 mg/kg/hr
- Onset 45-90 seconds
  - Peaks 30 minutes
- MOA
- Sodium channel blocker
- Able to blunt or block pain pathways
- Lidocaine infusions are able to exhibit anti-inflammatory properties

Magnesium Sulfate

- Maintenance Infusion 5-20 mg/kg/hr
- Given too quickly can cause hypotension



- MOA
- NMDA receptor antagonist
- Prevents depolarization of postsynaptic neurons.

Preoperative Plan

- Regional anesthesia highly recommended for opioid free anesthesia
- Acetaminophen 15mg/kg → 1000mg PO/IV
  - Consider reducing or omitting dose if patient has hepatic dysfunction
- Celecoxib 6mg/kg → 400mg PO
  - Considering omitting or reducing dose in renal insufficiency or potential for bleeding
- Pregabalin or gabapentin
  - Pregabalin 5mg/kg → 150mg PO (adjust for renal function)
  - Gabapentin 15mg/kg → 600mg PO (adjust to 300mg max for reduced renal function and >70 years old)
    - Pregabalin is preferred as higher doses of gabapentin may cause increased sedation

Intraoperative

Induction

- Ketamine 0.3-0.5mg/kg
- Lidocaine 1mg/kg
- Decadron 0.2mg/kg
- Dexmedetomidine 0.5-1mcg/kg

Maintenance

- Lidocaine 1.5mg/kg/hr
  - Beneficial in addition to regional anesthesia but consider reducing or omitting if high concentration block is placed
- Ketamine 0.25mg/kg/hr
- Dexmedetomidine 0.4mcg/kg/hr
- Magnesium 30mg/kg → 2g single dose or
  - Infusion - 5-20mg/kg/hr

Emergence

- Discontinue infusions 30 minutes prior to end of surgery
- Ondansetron 0.15mg/kg → 8mg
- Ketorolac 0.5mg/kg → 30mg if no other NSAIDs administered
- Standard postoperative orders

Quick Reference Guide

PRE OPERATIVE	INTRA OPERATIVE		POST OPERATIVE
	Induction	Maintenance	
Consider Regional or Local Anesthetics			Ondansetron 0.15mg/kg -> 8mg
Acetaminophen 15mg/kg -> 1000mg PO/IV	Ketamine 0.3-0.5mg/kg	0.25mg/kg/hr	Ketorolac 0.5mg/kg -> 30mg (if other NSAIDs not given)
Celecoxib 6mg/kg -> 400mg PO	Lidocaine 1mg/kg	1.5mg/kg/hr	Standard post operative medications
Pregabalin 5mg/kg -> 150mg PO	Decadron 0.2mg/kg	N/A	
OR	Dexmedetomidine 0.5-1mcg/kg	0.4mcg/kg/hr	
Gabapentin 15mg/kg -> 600mg PO	Magnesium 30mg/kg -> 2g single dose	OR 5-20mg/kg/hr	

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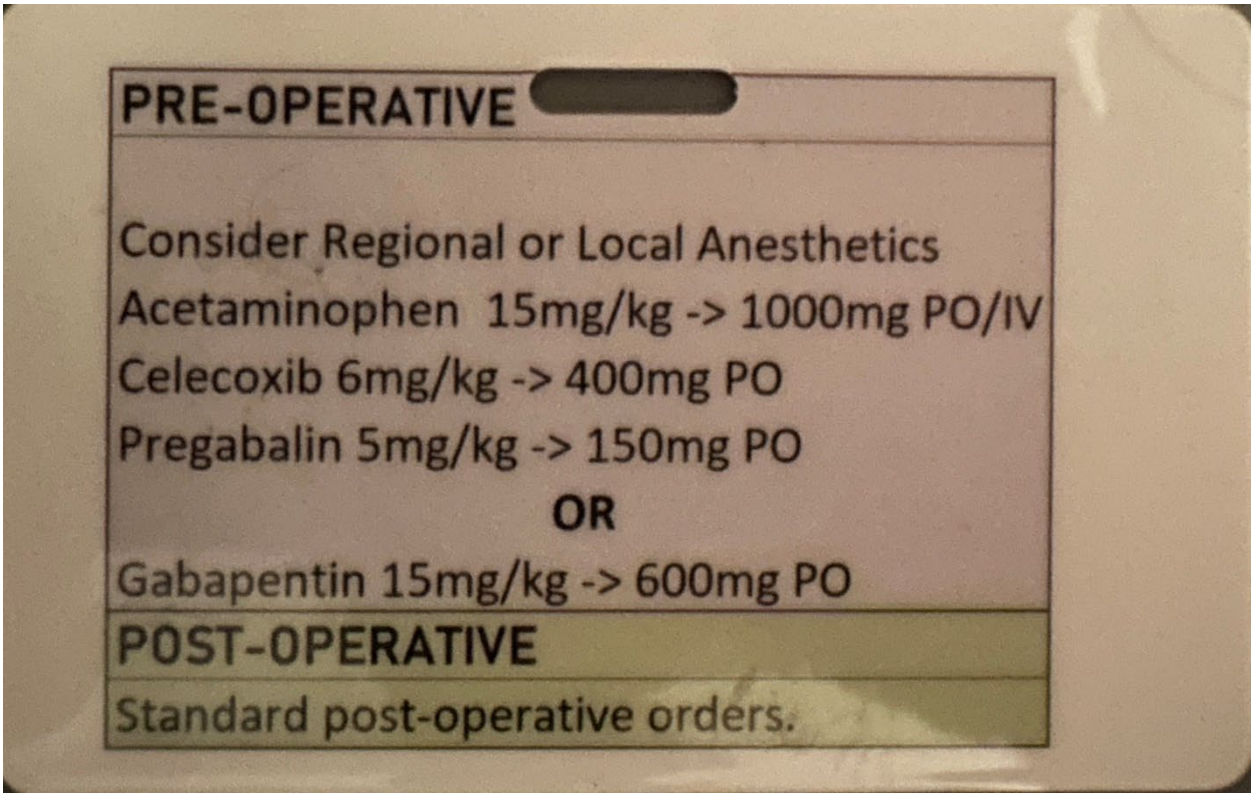
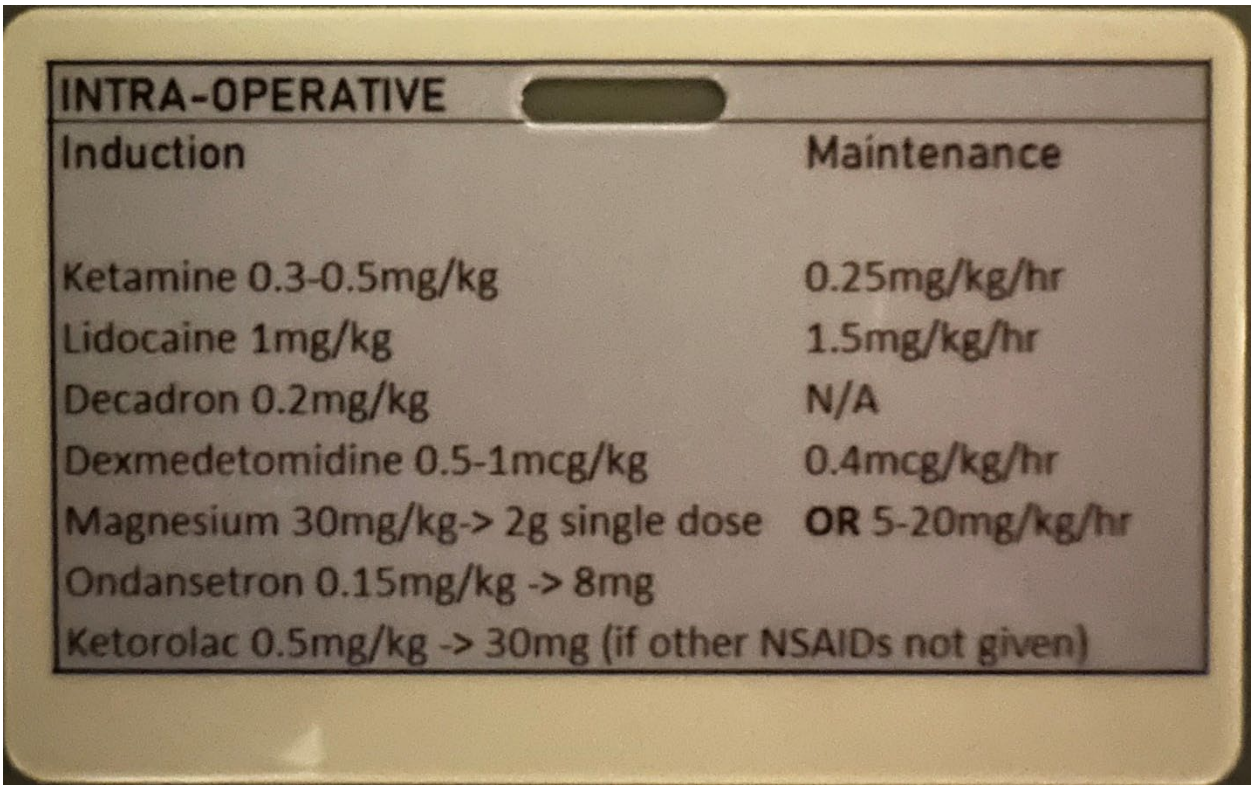
Appendix E: Opioid-Sparing Protocol Quick Reference Guide



PRE-OPERATIVE
Consider Regional or Local Anesthetics Acetaminophen 15mg/kg -> 1000mg PO/IV Celecoxib 6mg/kg -> 400mg PO Pregabalin 5mg/kg -> 150mg PO **OR** Gabapentin 15mg/kg -> 600mg PO
POST-OPERATIVE
Standard post-operative orders.



INTRA-OPERATIVE	
Induction	**Maintenance**
Ketamine 0.3-0.5mg/kg	0.25mg/kg/hr
Lidocaine 1mg/kg	1.5mg/kg/hr
Decadron 0.2mg/kg	N/A
Dexmedetomidine 0.5-1mcg/kg	0.4mcg/kg/hr
Magnesium 30mg/kg-> 2g single dose	**OR** 5-20mg/kg/hr
Ondansetron 0.15mg/kg -> 8mg	
Ketorolac 0.5mg/kg -> 30mg (if other NSAIDs not given)	

Appendix F: Post-Intervention Survey

Demograhics

What is your age?

- ○ 25-34
- ○ 35-44
- ○ 45-54
- ○ 55-64
- ○ 65 or older

What is your gender?

- ○ Male
- ○ Female
- ○ Non-binary / third gender
- ○ [ ] Other
- ○ Prefer not to say

How long have you been a practicing anesthesia provider?

- ○ Less than 5 years
- ○ 5-9 years
- ○ 10-14 years
- ○ 15-19 years
- ○ 20-24 years
- ○ 25 years or longer

Was your anesthesia training at masters level or doctorate level?

- ○ Masters Degree
- ○ Doctorate Degree

If you do not have a doctoral degree, do you plan to obtain one in the future?

- ○ Yes
- ○ No
- ○ N/A, I already have a doctoral degree.

I used the opioid-sparing/free protocol frequently.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

Attitude/Barriers

I found the opioid-sparing/free protocol to be useful and/or user-friendly.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

After implementing the protocol, I believe opioid-free/sparing anesthesia is impractical.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

After using the protocol, opioid-free/sparing anesthesia is still of no interest to me.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

I do not plan to include opioid-sparing techniques in my practice in the future.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

Learning opioid-free/sparing techniques was not worth the effort or the time.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

I currently use/will start using opioid-free/sparing techniques in my practice whenever possible.

- ○ Strongly disagree
- ○ Somewhat disagree

- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

I believe the opioid epidemic has been exaggerated.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

After using the protocol, opioid-free/sparing anesthesia is less effective than traditional anesthesia including opioids.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

In my experience, opioid-free/sparing techniques lead to worsened pain control for patients.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

Our facility culture is supportive of opioid-free/sparing anesthesia techniques.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

I feel as though surgeons at my facility would be willing to adopt opioid-free/sparing techniques.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

Cost may be a prohibitive barrier to implementing opioid-free/sparing techniques at my facility.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

I have access to a variety of anesthesia techniques and equipment such as ultrasound, nerve blocks, epidurals, and spinals.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

I have access to a variety of non-opioid medications such as NSAIDs, ketamine, dexmedetomidine, magnesium, acetaminophen, dexamethasone, and lidocaine.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

Please write any additional comments or thoughts about YOUR attitude or perception of opioid-sparing or opioid-free anesthesia.

Confidence

Using the opioid-sparing/free protocol improved my confidence.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

I feel immense satisfaction successfully using opioid-free anesthesia.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

I found the brief reference guide with the opioid-sparing protocol helpful in my everyday practice.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

My patients often wake up pain-free when using opioids.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

My patients often wake up pain-free when using opioid-free/sparing techniques.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

Opioid-free/sparing techniques were included in my training or education.

- ○ Yes
- ○ No

I would be willing to educate colleagues on opioid-free/sparing anesthesia.

- ○ Yes
- ○ No
- ○ Maybe/Unsure

Opioid Use Disorder

How often do you provide anesthesia care for patients recovering from opioid use disorder?

- ○ Never
- ○ A few times per year
- ○ Once per month
- ○ Weekly
- ○ Daily

When providing anesthesia for patients IN RECOVERY from opioid use disorder I find it harder to control their pain.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

How often do you provide care for patients with ACTIVE opioid use disorder?

- ○ Never
- ○ A few times per year
- ○ About once per month
- ○ Weekly
- ○ Daily

When providing care for patients with ACTIVE opioid use disorder I find it harder to control pain.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

Patients IN RECOVERY from opioid use disorders should NOT be given opioids as part of their anesthetic.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

Patients with ACTIVE opioid use disorders should NOT be given opioids as part of their anesthetic.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree